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The Babylonian Astronomy. By R. H. M. Bosanquet and Prof. A. H. Sayce.

No. 3. *The Venus Tablet.*

The name of the planet *Venus*, in the writings of ancient Babylon is known to us with as great certainty as any word in the inscriptions. In the small list of words preserved by Hesykhius, there is the word δελεφάτ, which he gives as the name of the Babylonian Venus. The word Dilbat occurs in the inscriptions as the name of a planet, and corresponds generally, as to its place in the lists, with *Venus*. The planet Dilbat is further identified with the goddess Istar,* and sometimes also with the goddess Anunit.† Istar in turn, regarded as a star, was called Nin-śi-anna, "Lady of the defences of heaven." To show clearly our authority for this statement, the following words are written down, exactly representing two corresponding lines of an inscription in two parallel columns.

W. A. I. ii. 59. 20 (2).

Divine Ninśianna.	Divine Istar; a star.

We thus arrive at the name Ninśianna as a name commonly used for Venus.

The tablet which forms the subject of the present communication speaks of the "divine Ninśianna" throughout. The tablet is a good deal broken, but a considerable number of observations survive. The following is the translation of the

* See *Trans. Soc. Bibl. Arch.* iii. 197; also *W. A. I.* (*Western Asiatic Inscriptions*), ii. 49, 11.

† *W. A. I.* ii. 49, 12.

tablet. For the text see *W. A. I.* iii. 63 and *Trans. Soc. Bibl. Arch.* iii. 316.

OBVERSE.

LINE.

1. . . . . .
2. . . . . Venus disappeared, and the 2nd day Venus . . . .
3. . . . . for a year are. A destruction takes place.
4. In the month Tammuz, the 25th day, Venus at sunset disappeared.
5. The 7th day* in heaven it is visible; and in the month Ab, the 2nd day, Venus
6. at sunrise is seen. Waters in the land are. Beating of . . . .
7. In the month Adar, the 25th day, Venus at sunrise disappeared.
8. For a year service continues. Gold . . . .
9. In the month (Sivan) the 11th day† Venus at sunset disappeared. The 9th month, the 4th day, in heaven it was visible; and
10. in the month Adar, the 15th day, at sunrise it is seen. King to king peace sends.
11. In the month Marchesvan, the 10th day, Venus at sunrise disappeared. The 2nd month, the 6th day, in heaven it appeared.‡
12. In the month Tebet, the 16th day, at sunset it is seen. The crops of the land are prosperous.
13. In the month Elul, the 26th day, Venus at sunset disappeared. The 11th day, in heaven it appeared.
14. In the second Elul, the 7th day, at sunset it is seen. The heart of the land is good.
15. In the month Nisan, the 9th day, Venus . . . . disappeared. The 5th month, the 16th day, in heaven (it reappeared; and)
16. In the month Elul, the 25th day, at sunset it is seen. The heart of (the land is good).
17. In the month Iyyar, the 5th day, Venus at sunset is seen . . . . in heaven it appeared; and
18. At sunrise it is seen. The crops of the land are good . . . . the 10th day at sunrise . . . .
19. At sunrise it disappeared. The 15th day in heaven . . . . In the month Sebat, the 11th day at sunset . . . .
20. In the month Ab,§ the 10th day, Venus at sun . . . . The 1st month,‖ the 16th day . . . .
21. In the month Marchesvan, the 26th day, at sunset it is seen . . . ; Rains in the land are . . . .

* L. 5. The comparison of the interval of 7 days with the preceding and following observations shows that the month was here supposed to be 30 days

† L. 9. It is established, by comparison of passages in which a number of months and days is mentioned, that in all such cases reference is made to the interval between two observations, and not to the year-number of the month. Here the interval permits us to restore the month of the first observation, which is Sivan; it will appear from the subsequent discussion that this date belongs to the appearance at sunset, not to the disappearance.

‡ L. 13–14. Month of 30 days.

§ L. 20–21. Mistake in the month-number of one of the three entries.

‖ Or "after one month and 16 days."

22. In the month . . . . the 20th day, Venus at sunset disappeared. The 2nd month, the 16th day . . . .
23. In the month . . . . the 4th day, at sunset it is seen. Rains in the land are.
24. In the month . . . . the 6th day, Venus at sunset disappeared The 15th day . . . .
25. In the month . . . . the 20th day, at sunset it is seen. Rains in heaven, floods in the channels are . . . .
26. In the month Adar, the 26th day, Venus at sunrise disappeared. The 3rd month, the 9th day . . . .
27. In the month Sivan, the 20th day, at sunset it is seen. The forces of barbarian soldiery are collected . . . .
28. In the month Adar, the 11th day, Venus at Sun . . . . (disappeared). The 4th day in heaven . . . .
29. The crops of the earth flourish. The heart of the land is good.
30. . . . . wind, rain, snow, ...*

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31. †In the month Nisan, the 2nd day, Venus at sunrise is seen. Deserts in the land are.
32. Up to the 6th day of the month Chisleu at sunrise it is fixed.‡ The 7th day of Chisleu it disappears, and after 3 months in heaven
33. It appears; and the 8th day of the month Adar, Venus at sunset rises and king to king hostility sends.
34. In the month Iyyar, the . . . . day, Venus at sunset is seen Hostile bands in the land are.
35. (Up to the 7th day of) the month Tebet at sunset it is fixed.§ The 8th day of Tebet it disappears; and
36. (The 7th day in heaven) it appears; and the 15th day of Tebet, Venus
37. At sunrise rises; and the crops of the land are flourishing, the heart of the land is good.
38. (In the month Sivan, the 4th day) Venus at sunrise is seen. An inundation in the land.
39. (Up to the 8th day of the month Sebat) at sunrise it is fixed. The 8th day of Sebat it disappears; and
40. After (3) months in heaven appears; and the 9th day of the month Iyyar, Venus
41. At sunset rises; and hostile bands in the country are.
42. In the month Tammuz, the 5th day, Venus at sunset is seen. Hostile bands in the land are. The crops of the land flourish.
43. Up to the 9th day of the month Adar at sunset it is fixed. The 10th day of Adar it disappears; and
44. The 7th day in heaven it appears; and the 7th day of the month Adar, Venus
45. At sunrise rises; and king to king hostility sends.

* L. 30. Here the tablet marks the end of a paragraph.
† L. 31. Change of style and grammatical usage. Probable beginning of the spurious part. See *post.*
‡ L. 32. *I.e.* seen.
§ L. 35. *I.e.* seen.

REVERSE.

1. In the month Ab, the 6th day, Venus at sunrise is seen. Rains in heaven are. A beating takes place.
2. Up to the 10th day of the month Nisan, at sunrise it is fixed. The 11th day of Nisan it disappears; and
3. After 3 months in heaven it is seen; and the 11th day of the month Tammuz, Venus at sunset
4. Rises; and hostile bands in the land are. The crops of the land are prosperous.
5. In the month Elul, the 7th day, Venus at sunset is seen. The crops of the land flourish. The heart of the land is good.
6. Up to the 11th day of the month Iyyar, at sunset it is fixed. The 12th day of Iyyar it disappears; and
7. After 7 days in heaven it reappears; and the 9th day of the month Iyyar, Venus
8. At sunrise rises; and hostile bands in the country are.
9. In the month Tisri, the 8th day, Venus at sunrise is seen. Hostile bands in the land are. The crops of the land flourish.
10. Up to the 12th day of the month Sivan at sunrise it is fixed. The 13th day of Sivan it disappears; and
11. After 3 months in heaven it reappears; and the 13th day of the month Elul, Venus
12. At sunset rises; and the crops of the land are prosperous; the heart of the land is good.
13. In Marchesvan, the 9th day, Venus at sunset is seen. The land a strong woman seizes.
14. Up to the 13th day of the month Ab, at sunrise it is fixed. The 15th day of Ab, it disappears and
15. The 7th day in heaven it reappears; and the 11th day of the month Tammuz, Venus
16. At sunrise rises; and hostilities in the land are. The crops of the land flourish.
17. In the month Chisleu, the 10th day, Venus at sunrise is seen. Want of corn and barley in the land is.
18. Up to the 14th day of the month Ab, at sunrise it is fixed. The 15th day of Ab, it disappears and
19. After 3 months in heaven it reappears; and the 15th day of Marchesvan, Venus
20. At sunset rises; and the crops of the land are prosperous.
21. In the month Tebet, the 11th day, Venus at sunset is seen. The crops of the land flourish.
22. Up to the 15th day of the month Elul, at sunset it is fixed. The 16th day of Elul it disappears; and
23. After 7 days in heaven it reappears; and the 23rd day of the month Elul, Venus
24. At sunset rises, and the crops of the land are prosperous.
25. In the month of Sebat, the 12th day, Venus at sunrise is seen. The crops of the land flourish.

26. Up to the 16th day of the month Tisri, at sunrise it is fixed. The 17th day of Tisri it disappears; and
27. After 3 months in heaven it reappears; and the 17th day of the month Tebet, Venus
28. At sunset rises; and . . . .
29. In the month Adar, the 13th day. Venus at sunset is seen. The king . . . .
30. Up to the 17th day of Marchesvan, at sunset it is fixed. The 18th day of Marchesvan, Venus
31. The 7th day in heaven reappears; and the 25th day of Marchesvan, Venus
32. At sunset rises; and the land a strong woman seizes.
33. Twelve collections of observations of the risings of Venus in parallel columns (Accadian and Assyrian) of Babylon.
34. In the 2nd Elul, the 1st day. Venus at sunset disappears.*
35. The 15th day in heaven it is seen; and in the 2nd Elul, the 17th day, Venus
36. At sunrise is seen. A prodigy in the land is; in the palace . . . .
37. In the month Sivan, the 25th day, Venus at sunrise disappears . . .
38. After 2 months, the 6th day, in heaven it is seen; and in the month of Elul, the 24th day,
39. Venus at sunset is seen. The heart of the country is good.
40. In the month Nisan, the 26th day, Venus at sunset disappears; and
41. After 7 days in heaven it reappears; and the month Iyyar, the 3rd day, Venus
42. At sunrise is seen. Hostile bands in the land are. The crops of the land are prosperous.
43. . . . . Venus at sunrise disappears, and
44. . . . . in the month Adar, the 28th day, Venus
45. . . . . king to king an ambassador sends

The two following lines, which complete the tablet, are broken off.

It will be seen that there are no year-dates in this tablet; consequently it might be supposed that no further information is obtainable from it. And, indeed, it has been supposed that the observations were probably isolated, and the whole practically of no interest.

Tested, however, by a simple application of the synodical period, we find that the observations link themselves into a certain number of numerical schemes: so that portions of the tablet in question almost certainly refer to continuous series of phenomena. And the different portions of the tablet present differences in the numerical schemes according to which they are constituted, the discussion of which leads to singular results.

We confine ourselves in the first instance to the numbers of

* L. 34. Here begins a new paragraph.

months concerned. This affords a rough test of the synodic period, without involving hypotheses as to detail.

It will be desirable to recall approximate values of the synodic periods of *Venus* and *Mercury*. For *Venus* the number is about 514^d, say 19·2 mean months, or about 19·7 lunar months; for *Mercury*, less than 4 months. The value in the case of *Mercury* is only needed to assure us that no confusion has taken place with that planet.

We will now form an analysis of the dates of the tablet, mentioning in each case only the characteristic number of the month mentioned. These numbers are:—

1 Nisan.	5 Ab	9 Chisleu.
2 Iyyar.	6 Elul.	10 Tebet.
3 Sivan.	7 Tisri.	11 Sebat.
4 Tammuz.	8 Marchesvan.	12 Adar.

Lines of Tablet.	Sunset. Appears.	Is seen.	Disappears.	Sunrise. Appears.	Is seen.	Disappears.
			Obverse.			
4– 7			4	5		12
10–11	3		. . . .	12		8
11–15	10		6	7 (2nd Elul)		1
15–19	6		2	. . . .		. . . .
19			11 (?)	. . . .		5 (?)
21–22	8					. . . .
24–26		. . . .	. . . .	. . . .		12
27	3		[12]			
31–32				1		9
33–39	12	2	10	10	3	11
40–45	2	4	12	12		
			Reverse.			
1– 2					5	1
3–10	4	6	2			3
11–18	6	8	[5]	4		5
19–26	8	10	6	[6]	11	7
27–32	10	12	8	[8]		
33		12 collections of observations, &c.				
34–37			7	7		3
38–43	6		1	2		[ ]
44	12					

(Two lines broken off.)

We have first to consider whether the numbers afford proof or probability of the observations being consecutive. This we answer at once in the affirmative.

The following scheme represents the differences of the month-numbers in the successive rows. This shows all the synodic periods of which both ends are given. It affords a means of appreciating the differences of character in the different parts of the tablet.

Differences of successive Rows.

Lines of Tablet.	Sunset. Appears.	Sunset. Is seen.	Sunset. Disappears.	Sunrise. Appears.	Sunrise. Is seen.	Sunrise. Disappears.
			Obverse.			
4–7						
7–11				19		20
11–15	19			19		19
15–19	18		20			
19						
21–22						
31–32						
33–39				21		26
40–45 and Reverse 1–2	26	26	26	26	26	26
3–10	26	26	26	26	26	26
11–18	26	26	27	26	26	26
19–26	26	26	25	26	26	26
27–32	26	26	26	26		
			12 collections of observations, &c.			
34–37				18		19
38–43	18					
44						

We see at once that the successions are of such a character as to leave no doubt of the continuity of portions of the scheme.

The first 20 lines contain numbers leading to 6 synodic periods between 18 and 20 months, and one of 17 months. The one of 17 is altered to 19, on noticing that it is preceded by a 2nd Elul, and admitting a second intercalary month. This and the remainder are compatible with the synodic period of *Venus*.

Then follow ten lines too imperfect for analysis.

In l. 31 there is one date which combined with the first corresponding number of the next part gives a period of 21 months; this is within the limits of error.

Then follows a sequence of numbers, commencing in line 32, and continuing uninterruptedly down to line 32 of the reverse.

Corresponding figures in successive lines differ by 2 throughout. Six phases are enumerated in every period, without a single omission; and every month-number, except one, throughout six synodic periods falls in exactly with an obvious numerical scheme. The synodic period thus definitely announced is 26 months. No assumption can get rid of the excess of at least 6 months over the period of *Venus*; and it is clear, not only that this portion of the tablet is a fabrication, but also that it is a fabrication by some person wholly unacquainted with the phenomena. There can be little doubt that the scribe, finding this portion of the ancient Babylonian tablet illegible, fulfilled his duty by reconstructing it out of his inner consciousness, for the benefit of the great astronomical collection of Sargon of Aganè. We may note that the part spoken of as spurious differs in style, grammar, &c., from the rest. But it was picked out by one of us from the numbers only, without any knowledge of these peculiarities.

The next line (33 reverse) is

"Twelve collections of observations of the risings of Venus in parallel columns (Accadian and Assyrian) from Babylon."

It is supposed that this is the colophon of the previous portion of the tablet, which is arranged in twelve well-defined short paragraphs or sentences. The text is not bilingual. We therefore suppose it to be copied or made up from an earlier bilingual text in the library of Babylon; the Accadian original being probably earlier still.

In what is preserved of the remaining lines of the tablet, we have three synodic periods of 18, 19, and 18 months respectively, the last observation of the last pair being incomplete. These are within the limits reconcilable with the true period of *Venus* by means of intercalary months. And we are bound to admit, consequently, that the observations bear *primâ facie* the stamp of genuineness.

Any further examination of the tablet may consequently be confined to the first 21 lines, and to what follows the line "Twelve collections of observations."

We proceed to consider somewhat more in detail the complete observations in the first 20 lines. The following is a scheme of these observations, in which the month-number is replaced by the number of complete months. Thus the 9th day of Nisan is written $0^m\ 9^d$.

	Sunset.		Sunrise.	
Lines.	Appears.	Disappears.	Appears.	Disappears.
	m d	m d	m d	m d
4– 7		3 25	4 2	11 25
9–11	2 11	—	11 15	7 10
11–15	9 16	5 26	6 7 (I)	0
15–19	5 25	1 5	—	—

The observations of the next few lines are too imperfect for certain discussion, though they might possibly be reconstructed.

The fact that the months whose length is accidentally given (see notes) are of 30 days, appears to point to a different calendar from that of the lunar months. We have calculated the synodic periods both on the assumption of months of 30 days, and of lunar months; the results are not in either case so completely in accordance as to decide the question. It is not improbable that the months were arbitrarily arranged from time to time, partly according to one rule, partly according to the other.

The observation to which (I) is affixed is in the month 2nd Elul—an intercalary, apparently foreign to the regular calendar, in which the intercalary was at the end of the year, and called *Veadar*.*

The synodic period of Venus is, according to our calculation, $583^{d}\cdot919864$. For the present purpose it will be sufficient to consider it as 584^{d}.

The synodic periods deduced singly from the differences of the above observations are:—

y m d	y m d	y m d	y m d
		1 7 13	1 7 15
1 7 5	—	1 6 22 (I)	1 4 29
1 8 9	1 7 9		

(1 y. = 12 months simply.)

	d	l.y. l.m. d.
Months of $29\frac{1}{2}$ days	584 =	1 7 $26\frac{1}{2}$
		y m d
Months of 30 days	584 =	1 7 14

(1 l.y. = 1 lunar year = 354d. 1y. = 360d.)

The first two numbers present coincidences which leave no doubt that during the observations of lines 4–11, the months were counted as of 30 days each.

The subsequent periods present deviations which seem to indicate first that intercalaries were introduced; also either that the text is corrupt (which is very probable) or that lunar months were returned to in the course of the series. The number $1^{y}\ 4^{m}\ 29^{d}$ is preceded by one intercalary month shown in an observation and denoted by (I); there also appears to be another intercalary month before line 12, as is obvious from the number $1^{y}\ 6^{m}\ 22^{d}$; and the two together would raise the $1^{y}\ 4^{m}\ 29^{d}$ to nearly $1^{y}\ 7^{m}$, which is within limits of calendar error. The number $1^{y}\ 8^{m}\ 9^{d}$ is not so easily accounted for. $1^{y}\ 7^{m}\ 9^{d}$ is within the limits of error, if it were not for the intervening intercalary. This makes the last number really $1^{y}\ 8^{m}\ 9^{d}$, some 12^{d} greater than is consistent with lunar months. Further, we

* See Norris's *Assyrian Dictionary*, i. 50.

must notice that appearances of the planet may probably have been delayed by cloudy weather. Therefore it is possible that on this ground certain of the observations may not accurately correspond to the phases in the synodic scheme.

We will now form the differences corresponding to two synodic periods. These are:—

y m d	y m d	y m d	y m d
	3 2 1	3 2 5	3 0 14
3 3 14	—		

	d	d l.y. l.m. d.
Months of $29\frac{1}{2}$		$2 \times 584 = 3\ 3\ 23\frac{1}{2}$
	d	y m d
Months of 30		$= 3\ 2\ 28$

It is clear from the first two numbers that there must, in any case, have been an intercalary month before line 12, as before suggested. This would cause the above numbers to assume the following form:—

y m d	y m d	y m d	y m d
	3 3 1	3 3 5	3 2 14
3 5 14	—		

The first two are within the limits of calendar and other error, especially if we suppose that lunar months were employed during a part of the period. The third is scarcely admissible unless we assume a third intercalary immediately preceding it. In any case, the fourth number is irreconcilable.

One pair of numbers gives us 3 synodic periods—the first and last of the above observations. The resulting number is:—

	y m d	
	4 9 10	
	d	d l.y. l.m. d
Months of $29\frac{1}{2}$		$3 \times 584 = 4\ 11\ 20\frac{1}{2}$
	d	y m d
Months of 30		$= 4\ 10\ 12$

It must be remembered that one intercalary is actually mentioned in the observations, and there is sufficient evidence of another. Taking these into account we find for the corrected interval given by the two extreme observations:—

y m d
4 11 10

counting the year at 12 months.

This coincides substantially with the number corresponding to lunar months.

We have decided for the present to content ourselves with presenting the above comments on this remarkable series of numbers. They sufficiently indicate the nature of the results

obtainable, without professing to give a final treatment of the subject. We have applied various corrections, and constructed various hypothetical calendars: but the results have not been such as to encourage us to produce them. It is possible that when more is known of the history of this ancient period the difficulties of the text may be more easily dealt with.

We may give one illustration of the application of a correction which seems at first sight feasible and even necessary, and yet has been definitely abandoned, at least for the present.

On the reappearance of *Venus* from the region of the Sun, or on its disappearance into the Sun's rays, it would seem that the vertical distance of *Venus* above the Sun, as the latter dips below the horizon, should determine the critical position when the planet is just seen. And according to the time of year, a definite vertical distance such as 12° corresponds to very different distances along the ecliptic. In order to obtain determinations of the synodic period, it would therefore be necessary to apply corrections which should reduce the dates to accurately corresponding configurations. Thus when the ecliptic is more inclined to the vertical, the appearance is later and the disappearance sooner by a certain amount depending, for a particular phase, on the inclination of the ecliptic. Although we cannot tell precisely when the equinox fell, yet assuming that it was approximately at the beginning of the year, it is easy to calculate rough values of these corrections. We have calculated them for each month, and examined the effect of their application. Their amount is considerable; and they appear to throw the observations into confusion. They spoil the synodic periods that do exist, and do not improve materially those that are faulty.

The explanation of this appears to be, that the visibility of *Venus* depends more on its (crescent) phase than on the vertical distance from the Sun in the horizon. If this be admitted, the distance from the Sun in the ecliptic becomes the only point of importance, and the substantial correctness of synodic periods derived directly from the observations is to some extent explained.

The observations which occupy the last lines of the tablet are as follows:—

	Sunset.		Sunrise.	
Line.	Appears. m d	Disappears. m d	Appears. m d	Disappears. m d
34–37		6 1	6 15 (I)	2 25
38–43	5 24	0 26	1 3	—
44	11 28 (? Imperfect.)			

	y	m	d		y	m	d
Differences	1	6	25	and	1	6	18

But on account of the intercalary 2nd Elul the corresponding synodic periods are—

y	m	d		y	m	d
1	7	25	and	1	7	18

One of these numbers would decide for the lunar months; the other for the 30 days. Unfortunately, we cannot decide between them.

As to the interval between the disappearance at sunset and the appearance at sunrise.

In two cases this interval is specified to be 7 days (lines 5, 41), but not elsewhere throughout the genuine portion. In line 13 this interval is specified as of 11 days, and in line 35 (rev.) as of 15 days. Throughout the portion which we consider not genuine, this interval is uniformly stated to be 7 days. A slight calculation shows that if we suppose *Venus* to be visible at sunrise or sunset when 12° from the Sun in the ecliptic, this interval should consist of 15 days nearly. It is possible that *Venus* may be visible in tropical regions when nearer to the Sun than this. But in order that the interval may be only 7 days, it is necessary that *Venus* should be visible when only 6° from the Sun in the ecliptic. We beg to call the attention of astronomers in tropical countries to the question at what distances from the Sun *Venus* can be actually seen at sunrise or sunset. But in the mean time we consider the interval of 7 days as highly doubtful, and casting a doubt upon an observation in each case where it occurs. Its uniform occurrence in the spurious part of the tablet is in accordance with this opinion.

As to the interval between the disappearance at sunrise and the appearance at sunset, calculation based on a distance of 12° from the Sun gives 54 days nearly. The numbers from the text are 76 days, 66 days, and 5 months 16 days. The two first numbers accord pretty well with what should happen, the distance from the Sun being taken as greater than 12°, since *Venus* is in the least bright portion of its course. The last number cannot represent an observation.

The number 89 days also occurs in the last lines of the tablet.

The only remaining point worth noticing is that if a tablet such as this were discovered, with first-hand observations, and any king's name, or mark of historical connection which would fix the date within, say, 100 years, it might be possible to fix the date more closely by means of our knowledge of the motions of *Venus*. Nothing of the kind is actually possible with this tablet, as there is no clue whatever to the age of the observations. But, with a view to possible discoveries, it may be well to state shortly the considerations involved.

It is well known that 8 years are nearly equal to 13 revolutions of *Venus*. If this were exactly true, the phases of *Venus* would go through a cycle in 8 years, forming 5 synodic revolutions, and the cycle would repeat itself in successive periods of 8 years. Since, however, the commensurability of mean motions is not exact, the dates of the phases at given points of the cycle do not remain fixed, but shift slowly. If then *Venus* has a definite phase on a given day of the year, the only possible dates are given by the shifting cycle, and it will appear that two such

possible dates for a given day are separated by an interval of 235 years nearly. If, therefore, we can assign the date approximately within, say, half one of these intervals, it is quite possible that we might be able to fix the date more closely by means of the observations of *Venus*.

The numbers are obtained as follows:—

(Herschel's *Outlines of Astronomy*, table at the end.)

Sidereal year	$365^{d}\cdot256361 = a$
Sidereal rev. of Venus	$224\cdot700787 = b$

in mean solar days. Whence synodic period in days

$$= \frac{ab}{a-b}$$

$$= 583^{d}\cdot919864$$

8 years (sidereal)	$= 2922^{d}\cdot05089$
5 synodic periods	$= 2919\cdot59932$
deviation of cycle	$= 2\cdot45157$

To examine the recurrence of the synodic revolutions in the cycle suppose the cycle to be true. Then the synodic period would be in mean months

$$\frac{96^{m}}{5} = 19^{m}\cdot2$$

and the synodic periods from the beginning of the cycle are—

y	m
0	0·0
1	7·2
3	2·4
4	9·6
6	4·8

after which the cycle begins again.

Now, suppose that at a given epoch *Venus* is in a given phase, and that this takes place at the zero of the cycle. Then (neglecting the eccentricity of the orbits and other corrections) *Venus* can only be in the given phase at the other times of the year shown in the column of months. For instance, this cannot occur between the month 0 and the middle of the month 3. But for ancient and future times the cycle is displaced to the extent above indicated.

The quantity which appears above as 2·4 mean months is, when calculated more accurately, $72^{d}\cdot070645$. Dividing this by

the deviation in one cycle and multiplying by 8^y, we find for the period of change through one interval of the cycle, $235^y \cdot 182$ (sidereal years).

It would be quite possible in this way to calculate the dates at which the observations of this tablet could have been made; but a conjectural element enters into the reconstruction of the calendar of the observations. And as there is nothing to associate these observations with historical dates, there is no possibility of a real contribution to ancient history in this case.

It is, however, amply proved that these observations do actually refer to *Venus*, except the portion which we have excepted as spurious. It is further shown that the writer of the tablet, which has come down to us from remote antiquity, was himself an ignorant copyist of an earlier tablet or tablets; but of what date are the observations of this earlier tablet or tablets there is no evidence to show, except the antique style, and the fact of their belonging to the collection supposed to have been made by Sargon of Aganè; which tends to refer them to a period older than 1700 years B.C.

The length to which this comment has extended, and other circumstances, compel us to postpone the discussion of the identification of stars, &c.

Addition to a Paper entitled "On the Theoretical Value of the Acceleration of the Moon's Mean Motion in Longitude produced by the Change of Excentricity of the Earth's Orbit." By Sir G. B. Airy, K.C.B., Astronomer Royal.

In a paper lately communicated to the Society, my principal object was to exhibit the power of a new or factorial method of obtaining the disturbance of the Moon's movements depending on the introduction or change of an external force; and I applied it to the disturbance called the "Acceleration of the Moon's Mean Motion," produced by a gradual change in the excentricity of the earth's orbit. In completing the calculation, and estimating for that purpose the external factor of the formula, I limited myself to the imperfect expressions for the change of magnitude of the force, which (historically) had been adopted in the earliest investigations. I now propose to employ the more complete formula; referring, when advantageous, to the preceding paper, and using it to abbreviate this communication where it appears possible to do so.

(19.) The Sun's disturbing action is to be treated here in the same form as in the preceding articles; employing the symbol T for the ecliptic tangential accelerating force, and P for the ecliptic radial force measured from the Earth, and using V and v for the true longitudes of the Sun and Moon, R for the Sun's radius vector, and r for the Moon's radius vector, A for